L. Selago resembles closely *L. Phlegmaria* in development, while *L. clavatum* and *L. annotinum* are alike. The entrance of the fungus at the peripheral or basal cell stimulates the apical cell to division. It cuts off from its two sides alternately five or seven segments in the *L. clavatum* type, and fewer in *L. Selago*. This closes the first period.

Extensive growth of both the prothallium and the fungus characterizes the second stage. Rapid radial growth at the apex results in a pear-shaped prothallium. The fungus in the two lycopod types of prothallium represents two species. In *L. clavatum* it forms a peripheral digestive mantle surrounding the central mass of storage cells. Limited from the central cells by a palisade layer, it becomes entirely intercellular. The fungus of *L. Selago* resembles in habit that of *L. Phlegmaria* and fills the entire prothallium posterior to the apical region except the epidermis. The sister cell of a rhizoid, infected by a branch of the mycelium from the hypodermis, serves as an "Expeditionszelle." From it the hypha passes out to the substratum, spraying out into fine branches. To this cell BRUCHMANN attributes the function of chemically attracting the fungus by its enzymes.

The third period has to do with the changes in the apical region. Marginal meristematic cells in *L. clavatum* surround the axial conductive cells, coextensive with the former storage cells. Reproductive organs develop on the margin, antheridia preceding archegonia. Such prothallia may live twenty years. During this period the fungus forms spores. In *L. Selago* the attempt to gain dorsiventrality causes extensive elongation of the prothallium, which at the soil surface develops chlorophyll. The apical growth becomes marginal, the central tissue acting as a storage region. The outer layers on one side develop paraphyses and sex organs; on the other, vegetative cells containing the fungus, which always remains intracellular.

The embryo-development of *L. Selago* agrees in detail with that of *L. Phlegmaria*. The root appears last, later than in *L. clavatum* and *L. annotinum*. The foot is smaller than that of *L. clavatum* and of *L. annotinum*, but less papillate than that of *L. Phlegmaria*. Its continued growth upward bursts the prothallium, whereupon it reaches the light and becomes green.—GRACE L. CLAPP.

Variation in timothy.—An important contribution to the subject of secular variation has been made by CLARK,[6] who has studied the variation in height, weight of forage produced, earliness of bloom, and duration of the period of bloom in timothy (*Phleum pratense*). Data were secured during three successive years on 3505 plants representing 163 pedigrees derived from 22 different states of the United States. As there can be no doubt that timothy, like many other plants which have been studied, consists of a number of distinct hereditary forms or biotypes, the extent of variation, which was found to be

[6] CLARK, C. F., Variation and correlation in timothy. Bull. 279, Cornell University. pp. 301–349. *figs. 111–150*. July 1910.

very great in all characters studied, may not be considered as having great significance, since the bringing in of still other pedigrees from other sections would doubtless have increased the range of variability. No perceptible correlation was found between earliness and height of the plants or between duration of bloom and height of plants. There appeared to be a slight negative correlation between the duration of bloom and weight, but this was very slight and possibly not significant. Between weight and height, as might be expected, there was considerable positive correlation, ranging from 0.274± 0.011 to 0.718±0.006. By securing data covering three years from the same series of plants, an interesting new relation has been developed, namely, the correlation between the condition of plants in one year as compared with the same plants in succeeding years, and for this correlation the author gives the name "coefficient of place-variation." This measures the extent to which an individual, found to have a given rank with respect to a variable character in one year, may be expected to hold the same rank in succeeding years, and is a very important consideration from the standpoint of the practical breeder. The correlation coefficients found ranged from 0.382±0.010 to 0.585±0.008. The lowest correlation was found in comparisons between non-consecutive years, as when 1905 was compared with 1907. This would naturally be expected, since there are more disturbing factors in two years than in one. These coefficients are considered rather low, and are taken to indicate the importance of comparing individuals during several years as a safe basis for selection in economic breeding, since there are very good chances that an individual observed to be superior in one season may be inferior in succeeding seasons.—GEO. H. SHULL.

Seeds of horseradish.—It is a well known fact that the horseradish (*Cochlearia Armoracia*) is generally sterile, though it produces a great abundance of flowers and not infrequently produces capsules. BRZEZIŃSKI[7] has induced the development of seeds by removing a circle of the bark from the upper portion of the root a short distance below the collum. Plants so treated produced a considerable number of good seeds, and in one year (1908) he secured 1500 seeds. Of 50 seeds sown in 1907, 30 produced plants, most of which succumbed to disease, but 9 of which grew to maturity. From the same (1906) crop, 200 seeds planted in 1908 produced only 20 seedlings, thus apparently indicating the rapid loss of vitality of the seeds. Only 6 of these reached maturity. These 15 mature seedling plants of the horseradish were not uniform, but were referable to two types, neither of which agreed with the characters of the parent. The ordinary horseradish is intermediate between these two types, though inclining much more strongly to one of them than to the other. Both types of seedlings proved to be somewhat fertile, producing a considerable number of seeds, even without the operation which induced seed-

[7] BRZEZIŃSKI, J., Les graines du raifort et les résultats de leurs semis. Bull. Acad. Sci. Cracovie, Session of July 5, 1909. pp. 392–408. *pls. 12–15.*